

IN THE CLAIMS

Claims 1-90 (canceled without prejudice to Applicant).

Claim 91 (new). A method for establishing whether a sample of an unknown composition is attributable to a known source, comprising:

providing a first mathematical array that includes a plurality of first empirical isotopic data from elements present in said source, said first mathematical array being fixed on a tangible medium of expression, said tangible medium of expression having said first mathematical array fixed thereon being an identification of said source;

obtaining a second mathematical array that includes a plurality of second empirical isotopic data from elements present in said sample, said second mathematical array being fixed on a tangible medium of expression, said medium with said second mathematical array fixed thereon being an identification of said sample;

wherein said empirical isotopic data of said first and second mathematical arrays comprises empirical isotopic data for a plurality of the same isotopes of the same elements; and

determining the probability that said sample is attributable to said source based upon a comparison of at least a portion of said first mathematical array to at least a portion of said second mathematical array.

Claim 92 (new). The method of Claim 91 wherein said first empirical isotopic data comprises data selected from the group consisting of one or more intrinsic concentrations of isotopes, one or more ratios of intrinsic concentrations of two isotopes, one or more mathematical products of intrinsic isotopic concentrations or

ratios, one or more lists of a plurality of mathematical products of intrinsic isotopic concentrations or ratios, one or more groups of any such lists, one or more groups of any such mathematical products, one or more groups of any such ratios, one or more groups of any such concentrations, one or more mathematical products of any such concentrations plus or minus their error added, one or more mathematical products of any such ratios plus or minus their error added, any such concentrations, ratios, lists, groups and mathematical products in quadrature, one or more of any such concentrations plus or minus their errors added, one or more of any such ratios plus or minus their errors added, factor analysis of any such concentrations, ratios, lists, groups, mathematical products, and any determinants and combinations thereof present in said source.

Claim 93 (new). The method of Claim 91 wherein said second empirical isotopic data comprises data selected from group consisting of one or more intrinsic concentrations of isotopes, one or more ratios of intrinsic concentrations of two isotopes, one or more mathematical products of intrinsic isotopic concentrations or ratios, one or more lists of plurality of mathematical products of intrinsic isotopic concentrations or ratios, one or more groups of any such lists, one or more groups of any such mathematical products, one or more groups of any such ratios, one or more groups of any such concentrations, one or more mathematical products of any such concentrations plus or minus their error added, one or more mathematical products of any such ratios plus or minus their error added, any such concentrations, ratios, lists, groups and mathematical products in quadrature, one or more of such concentrations plus or minus their errors added, one or more of any such ratios plus or minus their

errors added, factor analysis of any such concentrations, ratios, lists, groups, mathematical products, and any determinants and combinations thereof present in said sample.

Claim 94 (new). The method of claim 91 wherein said first mathematical array is provided in machine readable form.

Claim 95 (new). The method of claim 91 wherein said second mathematical array is provided in machine readable form.

Claim 96 (new). The method of claim 91 wherein at least a portion of said first mathematical array in machine readable form is associated with said source through manufacturing, marketing and use.

Claim 97 (new). The method of claim 91 wherein said first and second mathematical arrays and product information associated with said first mathematical array are fixed on a tangible medium of expression in machine readable form.

Claim 98 (new). The method of claim 97 wherein said first mathematical array and said product information are indexed to said source in the form of machine readable serial numbers, bar codes, and other numerical and alphabetical indicia.

Claim 99 (new). The method of claim 91 wherein said determining comprises considering that the probability is inversely proportional to the product of the dynamic ranges of each isotopic analysis undertaken.

Claim 100 (new). The method of claim 91 wherein said elements are selected from the group of elements consisting of carbon, hydrogen, oxygen, nitrogen, sulphur and combinations thereof, said isotopes being any of the thirteen stable isotopes thereof.

Claim 101 (new). The method of claim 91 wherein said elements are selected from the group of elements that have two or more isotopes, said isotopes being any of the 224 stable isotopes thereof.

Claim 102 (new). The method of claim 91 wherein said sample is selected from the group consisting of chemical samples, food samples, pharmaceutical ingredients, excipients of drug products, impurities in drug products, raw materials of drug products, drug products, combustible fuels, additives to combustible fuels, environmental and naturally occurring products, medical samples, pharmaceutical samples, explosive and ammunition samples, paint samples, gun powder samples, crude oil samples, petroleum distillate samples, hazardous waste samples, paper samples, ink samples, tire materials, paint and other coating samples, other batched product samples, and combinations thereof.

Claim 103 (new). The method of claim 91 wherein said source is selected from the group consisting of batched products, precursors of batched products, raw materials used in manufacturing batched products, and intermediates in manufacturing batched products and combinations thereof.

Claim 104 (new). The method of claim 97, wherein said first mathematical array is indexed to said product information in said medium of expression.

Claim 105 (new). The method of claim 104, wherein said product information may be displayed by identifying said first machine readable form and indexing the same to said product information.

Claim 106 (new). The method of claim 97, wherein said product information may be scrolled and/or downloaded or printed as desired.

Claim 107 (new). The method of claim 91, wherein said isotopes are selected from the group consisting of the 252 existing stable isotopes of known elements that have two or more isotopes.

Claim 108 (new). The method of claim 91, wherein said isotopes are selected from the group consisting of the 13 stable isotopes of a group of elements consisting of carbon, hydrogen, oxygen, nitrogen, sulphur and combinations thereof.

Claim 109 (new). The method of claim 91, wherein an error of identification is selected based upon the mathematical array chosen, the number of concentrations of isotopes utilized in said array, and the portion of said first array compared with said second array.

Claim 110 (new). The method of claim 91, wherein said concentrations of isotopes are determined by an analysis selected from the group of analyses consisting of bulk phase analysis and specific compound analysis.

Claim 111 (new). The method of claim 110, wherein said bulk phase analysis includes off-line dual inlet isotope ratio mass spectrometry (irMS) and on-line combustion coupled with high resolution isotope ratio monitoring/mass spectrometry (irmMS).

Claim 112 (new). The method of claim 110, wherein said specific compound analysis includes gas chromatography coupled with irMS (irmGCMS) and liquid chromatography coupled with irMS (irmLCMS).

Claim 113 (new). The method of claim 110, wherein said analysis includes nuclear magnetic resonance.

Claim 114 (new). The method of claim 97 wherein said first mathematical array, said second mathematical array and said product information are stored in memory on a machine together with said index; wherein said machine readable forms and product information are indexed; and wherein said machine readable forms once identified through the index presents stored product information in displayed form.

Claim 115 (new). The method of claim 114, wherein said product information may be scrolled through.

Claim 116 (new). The method of claim 114, wherein said product information may be printed.

Claim 117 (new). The method of claim 114, wherein said product information may be accessed through said index from said machine readable form of said mathematical array.

Claim 118 (new). The method of Claim 110 wherein said bulk phase analysis and said specific compound analysis each has a dynamic range equal to the observed range divided by the 1-sigma standard deviation.

Claim 119 (new). The method of Claim 110 wherein the precision of said bulk phase analysis and said specific compound analysis is the 1-sigma standard deviation of the analysis performed divided by the square root of the number of observations of said analysis.

Claim 120 (new). The method of Claim 91 wherein said obtaining step comprises obtaining intrinsic isotopic concentrations of C¹³, N¹⁵, O¹⁸ and H³ in a sample; and wherein the specificity of said determining is calculated by the following equation:

$$\text{Specificity} = (1\sigma - \delta^{13}\text{C}/\Delta\delta^{13}\text{C}) * (1\sigma - \delta^{15}\text{N}/\Delta\delta^{15}\text{N}) * (1\sigma - \delta^{18}\text{O}/\Delta\delta^{18}\text{O}) * (1\sigma - \delta\text{D}/\Delta\delta\text{D})$$

Claim 121 (new). The method of Claim 91 wherein the specificity of said determining step is inversely proportional to the product of the dynamic ranges of said isotopic analyses undertaken of said sample.

Claim 122 (new). The method of Claim 118 wherein the dynamic range is the range of values expected for an analysis divided by the 1-sigma standard deviation of that analysis.